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ABSTRACT

A study developed and tested a communication and physical environment scale (CAPES) that consisted of items formulated from previous theoretical and empirical research. Subjects, 52 workers in a warehouse and its offices, completed questionnaires about information dissemination in their organization, the quality of organizational relationships, and satisfaction with organizational outcomes. Results indicated that the CAPES scale was a highly reliable instrument that could differentiate between populations with known variations in physical environment. Item analyses results suggested that no items should be deleted from the scale. A further pragmatic benefit is that the scale was designed to be incorporated in the more encompassing ICA (International Communication Association) Communication Audit framework. (Tables of data are included, and a comprehensive list of references is appended.) (NKA)

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DEVELOPMENT OF THE COMMUNICATION AND PHYSICAL ENVIRONMENT SCALE

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ABSTRACT

DEVELOPMENT OF THE COMMUNICATION AND PHYSICAL ENVIRONMENT SCALE

This research develops and tests a communication and physical environment scale (CAPES) which can be used in conjunction with the ICA Communication Audit. The items used in the scale were drawn from theoretical and empirical literature related to this topic. The research reported here was conducted on a warehouse where organizational members occupied considerably different physical environments. The results revealed that this instrument was highly reliable, essentially unidimensional, and that it could differentiate between populations with known differences in their physical environment. The scale has considerable potential for use in future empirical investigations of the physical environment of organizations and offers many pragmatic advantages as well.

DEVELOPMENT OF THE COMMUNICATION AND PHYSICAL ENVIRONMENT SCALE

Spatial dimensions of time-space relations are fundamental to most scientific inquiry (Giddens 265; Urry 20). While communication science has paid increasing attention to time in the last decade, spatial properties of communication behavior have received relatively little attention. For a long time the social sciences generally have been spatially 'blind', unattuned to the effects of distance and positioning on human interaction (Massey 12). But "... spatial structure is now seen not only as an arena in which social life unfolds, but rather as a medium through which social relations are produced and reproduced" (Gregory and Urry, 3).

The physical environment of organizations, then, has many potential impacts on organizational communication, since it forms the context within which this communication occurs. Indeed, it has been suggested that spatial relationships effect communication in organizations, small groups, and different cultural settings in a variety of ways (Monge and Kirste 110-112; Rogers and Kincaid 303-305; Sommer). For our purposes the physical environment will be considered to be those elements of the built environment which surround and affect, by their spatial and functional elements, communication behaviors within organizations.

Many aspects of the physical environment have potential impacts including: proximity and its relationship to satisfaction (McCarrey et al. 402), job understanding (Johnson 23) and strong ties to information sources (Keller and Holland 747), and social density in its relationship to stress and communicative avoidance (McCarrey et

al. 402) and alternatively stimulation and task accomplishment (Szilagyi and Holland 31). In spite of this wealth of potential research areas, the impact of the physical environment on organizational communication is not well known (Davis 271; Sundstrom, Burt, and Kamp 101).

One reason for this state of affairs is the lack of instruments for systematically investigating this area. A review of recent Organizational Communication: Abstracts, Analysis, and Overview revealed that no scales have been used involving physical environment variables in recent years (Greenbaum, Falcione, and Hellwig). This research sought to correct this problem by developing an instrument grounded in previous research and conceptualizations of the physical environment.

The conceptual foundation for the CAPES scale comes primarily from two typologies/descriptions of the physical environment of organizations (Davis; Steele). Steele has defined the physical environment of organizations by six main functions: (1) shelter and security (4 items in the CAPES scale); (2) social contact (4 items); (3) symbolic identification; (4) task instrumentality (2 items); (5) pleasure (1 item); and (6) growth (2 items). While Steele's framework was perhaps the first systematic attempt at specifying elements of the physical environment which relate to organizational functioning, it was not directly developed to deal with organizationl communication.

On the other hand, Davis provided a framework for directly examining the linkage between the physical environment and organizational communication. He specified three primary dimensions of the physical environment which related to communication. The first

dimension Davis (272-274) identified, physical structure, related to architectural factors and semi-fixed features which act to regulate social interaction (six items). Physical stimuli, the second dimension, refers to aspects of the physical setting (e.g., noise) that intrude into individual awareness and thus influence their behavior (Davis 274-276) (5 items). Finally, symbolic artifacts are elements of the physical setting which guide the interpretation of the social setting, such as furnishings and amount of space assigned to individuals (Davis 276-280) (one item).

The numbers in parantheses reflect the number of items in the questionnaire which relate to these functions (see Table 1 for a list of the exact items). Since some of the functions overlap, the total is greater than the number of items in the scale. While the work of Steele and Davis provides useful guidelines in the construction of the CAPES, the constraints of a standardized instrument and a focus on organizational communication constrained the distrubution of items. For example, symbolic identification measures were not included since they are likely to vary considerably from organization to organization and they often will be idiosyncratic, given that they are context bound. A factor which mitigates against inclusion of items related to symbolic identification in a general scale. Since symbolic elements also represent a special, unique channel for sending messages (see Rapoport), they become part of communication itself rather than a class of variables which affect communication.

In addition to these comprehensive treatments of the physical environment other research has served as a source of items contained in the scale. Johnson (23) found that when others were visible to respondents, understanding of their job functions increased. Form

(729-730) has stressed the importance of mobility in influencing social interaction at the work place in industrial situations. McCarrey et al. (402) have stressed the importance of work place definitions. These specific elements of the physical environment of organizations were also specifically represented in the scale.

The following general instructions were given to respondents concerning this scale: "Your work related communication takes place in a definite physical setting. The next several questions relate aspects of your physical environment to two issues. Using a scale from 0 to 100, please indicate the following:"

In this particular application respondents were asked to evaluate the impact of these elements of physical environment on two organizational communication dimensions: "To what degree do the following aspects of your Physical Environment": (a) "help your Task Related Communication?" and (b) "contribute to your overall personal satisfaction with your communication with others?" Response to part a constitute a subscale which refers to a structural property of an organizations, namely task, which influences individual information processing needs. Part b constitutes a subscale which refers to relational satisfaction and, thus more generally, the communication climate of an organization. Prior research has distinguished these two fundamental dimensions as well (see Johnson and Smith 217).

This scale is designed to be incorporated in the ICA Communication Audit. From the first exploratory investigations into the measurement of organizational phenomenon some thirty-five years ago (Jacobsen and Seashore), the measurement of organizational phenomenon has grown to more systematic multi-method investigations. This is most clearly evidenced in the systematic work involved in the

ICA Communication Audit (see Goldhaber and Rogers). While it has been recognized that the format of the audit and the general classes of items measured may change because of contingencies of the organization studied (Barnett, Hamlin, and Danowski 456-457), few attempts have been made to systematically incorporate new elements within the audit itself. The research reported here examined both the psychometric properties of the CAPES scale and the efficacy of including it in the ICA Communication Audit.

METHOD

Background

This research was conducted in a consumer goods warehouse, distribution center (N= 52) which was a part of a larger organization. The physical structure was segregated into office and warehouse spaces (see Figure 1). The warehouse was divided by large and small bins, which were above eye level, with a large shipping area and conveyer belts to promote movement of goods. Due to the movement of materials, the presence of forklifts, and the general absence of acoustic dampening the warehouse could be noisy. The office was rather standard for this sort of arrangement and somewhat protected from the noise of the warehouse. Thus this organization had two distinct types of physical environments.

Sixty-one percent of the respondents reported that they had worked in their current position for less than five years, although on average they had worked for the warehouse for six to 10 years. Most workers were employed in the warehouse (n= 41). Twenty-four per cent of the workers held some sort of supervisory position. The bulk of the respondents (73%) were high school graduates and most respondents

(54%) were under 40 years of age.

Questionnnaire

The CAPES scales were embedded in an audit instrument (see Goldhaber and Rogers). They followed general scales which measured: how much information individuals received on a variety of topics (RECINFO); how good this information was (RECGOOD); how much they needed to receive (RECNEED); how much information they send to others (SENDINFO); how much they need to send (SENDNEED); how much information they receive from various sources (SOUREC); how good this information was (SOUGOOD); how much they needed to receive from that source (SOUNEED); the quality of organizational communication relationships (QUALREL); and how satisfied respondents were with organizational outcomes (ORGOUT).

The questionnaires were administered in groups of eight during the course of one day. Research assistants provided some additional instructions and supervised questionnaire administration. Fifty-two out of the fifty-seven possible organizational members participated for a response rate of 91.2%.

Scaling

Because of their greater precision and inherent advantage in discriminating between contingent organizational properties metric fractionation scales were used in this study rather than ordinal scales. These scales provided respondents with a standard anchored at one end with an absolute zero point and at the other by some arbitrary

value, in this case 100. The scales also had a middle stimulus of 50 representing an average value. This approach has a number of inherent advantages over more conventional scales, including: allowing for considerable variance, permitting fine discriminations, and not building error into the measurement process (see Barnett, et al. 458-459). Comprehensive research on a variety of organizations has shown that workers can use these scales, they use them reliably, and they result in greater discrimination of phenomenon (Barnett, et al. 470). Respondents were provided with detailed instructions on how to use this scale.

RESULTS

Item means and standard deviations for the scales are contained in Table 1 which also contains an exact wording of the questions. The task communication CAPES means ranged from 50.00 (NUMPEOPLE) to 66.89 (FREEMOVE). The personal satisfaction CAPES means ranged from 49.76 (ATTRACT) to 69.87 (FREEMOVE). The standard deviations were moderately high for all variables. In comparing the two scales only one significant difference, for NUMPEOPLE, was noted in the means, (t = -2.46, 48 d.f., two-tailed probability of .02).

Table 1 about here

The items are based on the theoretical literature presented earlier. In addition, the items were distributed to four other experienced organizational communication researchers to insure that they were sound operationalizations of theoretical constructs which fit into the context of the audit. The Chronbach's alpha's for both scales were quite good: .89 for the satisfaction scale and .88 for the task communication scale. The alphas if items removed, reported in Table 1, revealed that for both versions of the scale no significant gains would occur in reliability by removing any of the items from the scales.

Tables 2 and 3 present the results of the principal components factor analysis for the task and satisfaction versions of the scale respectively. These analyses were done with orthogonal factors and a varimax rotation. Since the results were quite similar they will be presented together. The results indicated a very strong first factor and a marginal second factor. The second factor's eigenvalue approaches 1, and reveals a very sharp drop relative to factor 1, followed by a smoother curve for subsequent factors. Thus this factor might be dismissed using criterian suggested by Van de Geer (147). Further only one item, NUMPEOPLE, did not load on the first factor while loading the most heavily on the second.

Tables 2 and 3 about here

Since the results for the scales were so similar, a canonical

correlation analysis was conducted to further explore the similarity of the scales. The results revealed eight significant canonical factors, with the first factor having a very high canonical correlation of .98. The factors, except for 6, were essentially 'mirror images' of each other, with items loading high for one scale on a particular factor also loading high on the other.

Table 4 about here

Table 5 presents the Pearson correlations for the summated audit scales. There was an extremely high correlation for the two CAPES scales r= .87. Generally the correlations of the CAPES scales with the other audit scales were not significant.

Table 5 about here

Discriminant analyses were conducted to assess whether the scale distinguishes between known populations with differing characteristics, thus providing a means of assessing the construct validity of the scale. The warehouse workers were divided between those who primarily occupied the office and those who worked in the warehouse itself- two considerably different physical environments. Since the discriminant function for the task scale was not significant it will not be reported at length here. The discriminant function for

the satisfaction scale, which was significant, and its results are presented in Table 6. The canonical correlation and Wilk's lambda indicated that the functions related significantly to the 'group' variable. Three of the indicators, in the following rank order, appeared to the be he most useful in distinquishing betwen office and warehouse workers: NOISE, ATTRACT, and PRIVATE. Finally, the classification analysis revealed that an exceptionally high number, 85.37%, of the grouped means were correctly classified.

Table 6 about here

DISCUSSION

The CAPES scale, since it rests on past theoretical and empirical work, and was evaluated by others working in this area, had at the outset at least face validity. This research indicated that the scale had very good reliabilities, at least comparable to the results for other audit scales (see Barnett et al. 464), and the item analyses results suggested that no items should be deleted from the scale. Factor analysis revealed one primary dimension for the task and satisfaction version of CAPES, with the second factor having a marginal impact and primarily attibutable to one variable NUMPEOPLE, which also was the only significantly different item in the results for the two separate versions of CAPES, as revealed by the t-tests. The items which loaded on this second factor probably reflect the

human environment of work, rather than the physical environment, and thus NUMPEOPLE might be considered for deletion from the scale in subsequent usage.

Since most of the results revealed near equivalence in the task and satisfaction subscales of CAPES a canonical correlation was conducted to determine if there was any major substantive differences between them. The results revealed an extremely high association between the two versions, which was further confirmed by the 'mirroring' of scale items on the individual factors. The overall pattern of results suggested that in future research only one of the versions could be used, with very little loss of information.

The correlations between the summated versions of the two CAPES subscales also was very high. However, generally there was not a high correlation between the CAPES and other audit scales, with the exception of the SOUGOOD, QUALREL, and ORGOUT. These subscales could be considered to be the most directly evaluative of the audit subscales, thus the physical environment scales appears to be most directly related to organizational outcomes. In addition, the correlations for the task subscale were a little lower, in general, than that for the satisfaction scale. This coupled with the other results suggest that the other audit scales generally are highly related to each other and appear to tap into the human relations/climate aspects of organizations. Thus the CAPES scale appeared to provide a different view of organizational communication phenomenon than the other audit scales.

The discriminant analysis revealed that the scale has the capability of distinguishing between populations with known differences related to its properties. While the function for the

task dimension was not significant, this was probably attributable to the relatively small n of this organization (n=11 for the office staff); a general problem for this study. The function for the satisfaction version was significant and primarily attributable to the three dimensions that on their face would be most important in this circumstance: NOISE, ATTRACT, and PRIVATE.

When using this scale in conjunction with the audit the results reported here suggest that the current number of items is appropriate. However, if the scale were to stand by itself, additional items could be included, which reflect more of a balance of the functions identified by previous researchers in this area. Specifically a way should be found to include in a more abstract, general form the category of symbolic identification messages. Future research could also investigate the relationships between this scale and observational measures of the physical environment; investigate its stability over time through test-retest correlations; and determine whether there is a substantial second factor.

While the n of this study, its inclusion in the audit, and the very nature of the organization examined constitute limitations to this study, the CAPES scale does appear to meet generally accepted standards of reliability and validity. The need for this sort of index are many. First, it offers the potential for directly linking perceptions to an element of organizations which can be more easily controlled and modified than such amorphous concepts as climate and culture. Second, measuring perceptions of physical environment follows a well established research tradition of measuring employee perceptions with scales, which is now achieving rich payoffs in a number of meta-analyses (e.g., Petty, McGee, & Cavender). Third, on

the pragmatic level this scale is inexpensive and easy to administer and fits well into the framework of a well established instrument. Fourth, previous measures use only one or two items to measure the physical environment and these items often have unknown psychometric properties.

In sum, reliability and validity research on CAPES demonstrated that the instrument had high reliability, was essentially unidimensional, and had construct validity. This scale has the further pragmatic benefit of being designed to be incorporated in the more encompassing ICA Communication Audit framework.

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TABLE 1

Means, Standard Deviations and Alphas for CAPES Items

Items	Means	Task Standard Deviations	Alpha	Means	Satisfaction Standard Deviations	Alpha
FREEMOVE - Your freedom to move around	66.89	24.06	.88	69.88	20.96	.88
NUMPEOPLE - The number of people in your immediate work area	50.00	29.60	.89	59.83	23.41	.89
DISTANCE - The physical distance between yourself and others	57.95	25.34	.87	63.90	18.79	.88
DEFINED - Having a clearly defined work space	57.95	26.62	.86	60.61	23.67	.87
SEECOS - Being able to see my coworkers	60.91	26.22	.86	62.44	26.06	.87
SEESUP - Being able to see my supervisor	60.68	25.62	.85	61.78	27.48	.87
CONTROL - Being able to control who I communicate with	63.55	25.85	.86	61.93	26.59	.87
NOISE - The level of noise	56.30	27.13	.88	50.37	25.58	.88
ACCESS - Having access to others	60.00	24.71	.86	58.05	26.69	.87
PRIVATE - Feeling I can conduct conversations in private	54.77	28.97	.86	54.15	28.46	.87
ATTRACT - The attractiveness of my work area	52.05	27.90	.86	49.76	27.50	.88

TABLE 2

Factor Analysis for Task CAPES

Items	Factor 1	Factor 2
SEESUP	.86*	
ATTRACT	.82	
CONTROL	.81	
DEFINED	.81	
ACCESS	.81	
PRIVATE	.74	
SEECOS	.72	.35
DISTANCE	.63	
FREEMOVE	.51	-.47
NUMPEOPLE		.76
NOISE	.50	-.57
Eigenvalue	5.43	1.40
Percentage of Variance	49.3	12.7

*Just items greater than .3 reported.

TABLE 3

Factor Analysis for Satisfaction CAPES

Items	Factor 1	Factor 2
DEFINED	.80	
CONTROL	.79	
SEESUP	.78	
PRIVATE	.73	
SEECOS	.73	.43
ACCESS	.73	
ATTRACT	.66	
FREEMOVE	.63	
NOISE	.62	
DISTANCE	.55	.38
NUMPEOPLE	.47	.72
Eigenvalue	5.21	1.15
Percentage of Variance	47.4	10.4

*Just items greater than .3 reported.

TABLE 4

Canonical Correlation Analysis for CAPES

Standardized Canonical Coefficients	Factors							
	1	2	3	4	5	6	7	8
Task Scale								
FREEMOVE	.13	-.22	-.28	.32	-.31	-.20	-.01	-.11
NUMPEOPLE	-.02	-.02	-.15	-.18	-.17	.33	-.68	.31
DISTANCE	-.00	-.15	.87	-.24	-.07	-.17	.63	-.20
DEFINED	.32	.09	-1.23	.11	.09	-.56	-.08	-.39
SEECOS	.06	-.48	-.08	.56	.05	-.20	.49	.91
SEESUP	-.12	.59	.27	-.86	-.49	-.54	-.86	.59
CONTROL	.42	-.55	.27	-.22	.79	.03	-.84	-.68
NOISE	-.00	-.01	.36	-.14	.16	-.68	.34	.55
ACCESS	.05	.43	.65	1.28	.03	.60	-.48	-.82
PRIVATE	.67	.17	-.08	-.44	-.94	.43	.75	.52
ATTRACT	-.44	.37	.13	-.11	1.02	.60	.59	.03
Personal Satisfaction Scale								
FREEMOVE	.27	-.27	-.48	.30	-.59	-.67	.29	.26
NUMPEOPLE	.06	-.10	-.29	-.19	.03	.23	-.47	.46
DISTANCE	-.06	-.18	.69	-.17	-.03	-.41	.42	-.17
DEFINED	.09	.38	.80	-.06	.32	-.07	-.46	-.78
SEECOS	-.12	-.39	.10	.65	.18	.15	.49	.74
SEESUP	-.17	.46	-.02	-.60	-.41	-.67	-.77	.42
CONTROL	.61	-.56	.18	-.39	.75	.12	-.64	-.32
NOISE	-.10	.36	.06	-.29	.17	-.36	.24	.32
ACCESS	.15	.18	.48	1.27	.08	.48	-.08	-.33
PRIVATE	.49	.28	.31	-.30	-.74	.74	.60	.11
ATTRACT	-.25	.26	-.11	-.11	.66	-.01	.60	-.00
Eigenvalue	.96	.93	.90	.87	.83	.75	.52	.44
Canonical Correlation	.98	.96	.95	.93	.91	.86	.72	.66
Sig (P<)	.01	.01	.01	.01	.01	.01	.01	.01

N=41

TABLE 5

Pearson Correlations for Summated Audit Scales

SCALES	CAPES TASK	CAPES SAT	REC-INFO	REC-GOOD	REC-NEED	SEND-INFO	SEND NEED	SOU-REC	SOU-GOOD	SOU-NEED	QUAL-REL	ORG-OUT
CAPES-TASK	1.00											
CAPES-SAT	.87**	1.00										
RECINFO	.34	.35	1.00									
RECGOOD	.33	.35	.93**	1.00								
RECNEED	.15	.34	.48**	.55**	1.00							
SENDINFO	.23	.26	.61**	.66**	.40*	1.00						
SENDNEED	.17	.28	.26	.40*	.54**	.83**	1.00					
SOUREC	.24	.31	.61**	.64**	.56**	.67**	.63**	1.00				
SOUGOOD	.42*	.55**	.41*	.51*	.43*	.55**	.57**	.81**	1.00			
SOUNEED	.01	.20	.23	.34	.59**	.68**	.79**	.54**	.49**	1.00		
QUALREL	.38*	.39*	.42*	.41*	.65**	.52**	.52**	.68**	.71**	.33	1.00	
ORGOUT	.59**	.47**	.65**	.72**	.20	.36*	.10	.45*	.53**	-.01	.50**	1.00

*P < .05

**P < .01

TABLE 6

Discriminant Analysis for Satisfaction CAPES Scale

Statistics	Results
Standardized Discriminant Function Coefficients	
FREEMOVE	.26
NUMPEOPLE	.31
DISTANCE	-.09
DEFINED	.37
SEECOS	-.01
SEESUP	-.29
CONTROL	-.33
NOISE	.67
ACCESS	.30
PRIVATE	.58
ATTRACT	-.63
Canonical Correlations	.67
Wilk's Lambda	.55
Chi-Squared	19.85
d.f.	11
$p<$	.048